

DIRECTIVE FOR MONITORING THE IMPACT OF SULPHUR DUST ON SOILS

FREQUENTLY ASKED QUESTIONS

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Alberta Environment and Water

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INTRODUCTION

Purpose of the Directive for Monitoring the Impact of Sulphur Dust on Soils – Frequently Asked Questions

In December, 2011, Alberta Environment and Water released a *Directive for Monitoring the Impact of Sulphur Dust on Soils* to update and replace the *Soil Monitoring Guidelines* under its 1989 *Air Monitoring Directive*. The new *Directive* specifies regulatory requirements and provides guidance for monitoring and mitigation of the impacts of sulphur dust on soils for those sulphur handling and processing facilities whose operational approvals have the foregoing requirements.

The *Directive for Monitoring the Impact of Sulphur Dust on Soils – Frequently Asked Questions (FAQs)* serves as a companion document for the new *Directive*. It is intended to be a living document to address operational questions from approval holders or their consultants. It may be periodically updated or amended.

GENERAL QUESTIONS

1. What is the *Directive for Monitoring the Impact of Sulphur Dust on Soils*?

The *Directive* specifies regulatory requirements and provides guidance for monitoring and mitigation of the impacts of sulphur dust on soils for those sulphur handling and processing facilities whose operational approvals have the foregoing requirements. This *Directive* is an update and replacement of the *Soil Monitoring Guidelines* under section II.C.3 and the Appendix A-7 of Alberta Environment's 1989 *Air Monitoring Directive*.

2. When will the new *Directive* become effective?

The new *Directive* will come into force for relevant approvals when they are amended to include the *Directive*. Prior to any approval amendment, the approval holders may voluntarily use the new *Directive*, but they will need to clarify the reporting requirements with the Director. In this case they must choose the new *Directive* or remain with the 1989 *Soil Monitoring Guidelines* in their entirety - they cannot use both.

3. What kinds of industrial operations are required to conduct soil monitoring for the impact of sulphur dust on soils?

Approval holders that handle solid elemental sulphur and also have the requirements in their approvals to monitor impacts of deposition of sulphur dust to soils, must conduct the soil monitoring program. Typically, these facilities handle and process solid elemental sulphur using blocks, base pads, prilling towers, granulating facilities, loading/unloading facilities, and/or store more than 100 tonnes of solid elemental sulphur.

4. If our plant only operates liquid elemental sulphur processing facilities, do we need to conduct soil monitoring for sulphur dust and its potential impact on soils?

Usually this is not required. Section 2 of the new *Directive* has granted an exemption to this type of facility, provided that any historical impacts to soils by solid elemental sulphur operation have been remediated to appropriate standards. Approval holders must follow the terms and conditions in their approvals.

5. When should our plant use this *Directive* or the 2009 *Soil Monitoring Directive*?

The *Directive for Monitoring the Impact of Sulphur Dust on Soils* focuses on lands in the vicinity of plants that handle solid elemental sulphur. It may also extend to selected locations within the boundary of a plant site when the overall pattern of deposition of sulphur dust needs to be assessed. Monitoring for the release of sulphur to soils within the plant boundary and releases of other substances to soils in general, is otherwise addressed by the *Soil Monitoring Directive* (AENV, 2009), as amended, under the corresponding approval.

QUESTIONS ABOUT MONITORING AND SAMPLING

6. **The new *Directive* indicates that composite soil samples must be used in all monitoring events to address the potential impacts of sulphur dust. How should the sampling be carried out in the field?**

A minimum of five separate soil samples must be collected within a five meter radius of a sampling location. The depth intervals defined in section 2.2.2.2 of the *Directive* must be followed. The samples must be composited within each depth interval for that location. Where it is possible, the composite samples should be mixed in the field.

7. **When determining soil bulk density at each major sampling location, should our plant determine the bulk density of all sampling intervals at all five sub-locations within a five meter radius of a major sampling location?**

Measurements of soil bulk density at one representative sub-location are adequate for the programs in the *Directive*. The bulk density data must be determined for each of the specified depth intervals as outlined in section 2.2.2.2. As measurements of soil bulk density can cause significant disturbance to a sampling location, it may not need to be measured again in the subsequent soil monitoring and mitigation events, unless the site is disturbed by new construction or change in land use.

8. **Some of our clients have older plants and they did not have baseline soil data prior to the introduction of the 1989 *Soil Monitoring Guidelines*. Can they compare their soil monitoring data against those of the older background locations?**

Yes. For some older plants where baseline soil data are not available, it is acceptable to use background locations as a surrogate baseline, provided that the locations are not affected by plant operations and the soil types are the same as the locations being monitored.

9. **The new *Directive* specifies a monitoring frequency of every other year, at a minimum. Our plant has just established a new operation which handles solid elemental sulphur. Can we conduct the Routine Monitoring Program on an annual basis so that we can understand the deposition patterns of sulphur dust faster?**

Yes. The plant may conduct annual monitoring as needed but must follow the reporting frequencies in the approval.

QUESTIONS ABOUT THE MITIGATION PROGRAM

- 10. Should we determine the exceedance of the operational threshold values by using the trends in the monitoring data over several years, or the most recent monitoring data?**
In the new *Directive*, impacts of sulphur dust to soils are defined by comparison of soil data from each monitoring event against the operational threshold values in section 3.2.3.1. Considering the dynamic nature of soil acidification, the most recent monitoring data should often give a more accurate assessment of the site. The trend in monitoring data will help to estimate the rates of soil acidification, or, where a mitigation plan is implemented, the rates of soil recovery.
- 11. Regarding the threshold values for mitigation, could Alberta Environment and Water clarify when to use the total sulphur analysis and when to use elemental sulphur analysis?**
Alberta Environment and Water has adopted a set of operational thresholds with multiple parameters in section 3.2.3 of the new *Directive*. All of those parameters must be determined in a Routine Monitoring Program.
- 12. Some baseline soils at our monitoring areas are alkaline. If those soils require liming, should our plant mitigate the soils to a neutral condition, or the alkaline condition?**
Where the soil has an alkaline baseline or background condition and the measured soil pH values in the Routine Monitoring Program still remain above 6.5, the benefits of liming may be outweighed by an adverse effect on the availability of nutrients to vegetation. Instead the Mitigation Program should focus on source control and protection of other sensitive ecosystem components of the land. The proponents should contact the regional staff members of Alberta Environment and Water for site-specific solutions.

If the soil pH is below pH 6.5 for agricultural soil, or pH 5.0 for forest soils, liming is needed and the targeted pH should be within the optimal range (pH 6.0-7.0 for agricultural soils, and pH 5.0-6.5 for forest soils) for nutrient uptake.

QUESTIONS ON ANALYTICAL METHODS

13. The new *Directive* requires some different analytical methods than the 1989 *Soil Monitoring Guidelines*. Are the facilities with existing monitoring programs required to use the new methods? How can we accurately compare results using the old versus new methods?

The soil analytical methods are normally updated in a 10-year period in scientific communities and improvements are often adopted along the way. Laboratory procedures for soil analyses need to be updated to remain relevant, and all approval holders are required to use the new methods, or equivalent methods that are otherwise authorized by the Director. One exception is explained in #15 below.

It is not anticipated that the updated methods will result in drastically different analytical results. If a new laboratory method does produce distinctly different results with quality-control samples of known concentrations, the laboratory may use the new method to either a) re-analyze any stored baseline samples, or b) analyze suitable background soil samples and use them as a surrogate baseline.

14. The 1989 *Soil Monitoring Guidelines* specifically stated that pH tests for organic soils and forest litter needed to be done at a 10:1 liquid to soil ratio whereas for mineral soils, a 2:1 ratio. Should we continue to use these ratios?

Yes. The above soil-specific ratios have been widely used in determination of soil pH and are cited in the references of the new *Directive*.

15. The new *Directive* has specified the calcium chloride (CaCl_2) method for determination of soil pH, can our plant use the water suspension method instead?

If the water suspension method has been consistently used by an approval holder to determine soil pH in previous monitoring events, it should be followed in the future to get comparable data.

16. The extraction efficiency for elemental sulphur with the chloroform extraction method by Watkinson et al. (1987) in the new *Directive* appears to be affected by the soil wetting procedure. How should our laboratory deal with that problem?

Published data on soils from New Zealand and United Kingdom indicated that wetting the soil to the moisture range of 0.5 water holding capacity or above the plastic limit gives complete recovery of elemental sulphur. Literature suggests that a 1:1 soil to water ratio works well with most soils. When less water is used, vigorous shaking needs to be incorporated into the extraction procedure. When too much water is used, it may cause formation of emulsions that reduces the recovery rate of elemental sulphur.

17. The new *Directive* cites both the acetic acid dissolution method and the carbon dioxide weight loss method for the determination of soil carbonates. Which method should we use for mineral soils and which for organic soils?

When mineral soils have a low carbonate content, the acetic acid method as modified by Ashworth (1997) works better. When mineral soils have a high carbonate content (5% or more) the acetic acid dissolution method will no longer be sensitive unless the amount of soil sample is markedly reduced. Alternatively, the carbon dioxide weight loss method can be used. For Organic soils, follow the carbon dioxide weight loss method because high amounts of organic matter can make the acetic acid dissolution method inaccurate.